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SmART: An Application Reconfiguration Framework

VIRTU
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UNIÃO EUROPEIA Fundo Europeu de Desenvolvimento Regional
QREN QUADRO DE REFERÊNCIA ESTRATÉGICO NACIONAL PORTUGAL 2007-2013
POR LISBOA

Introduction

- **Virtualization** importance is increasingly growing
- **Virtual machines** are easily replicated
- **Different configurations** for replicated virtual machines

Problem Identification

- No representations/tools to automatically configure applications
- Demand to **save time** in application configuration process
- Concerns at the level of **scale**, **automation** and **human intervention**

Solution Proposal

- SmART, a framework which:
  - Systemizes the process of configuring a group of applications
  - Configures any application, regardless of its vendor
- Resorts to the similarities between configuration files

Application Configuration Files

```
[mysqldump ]
quick
quote-names
max_allowed_packet = 16M
[ isamchk ]
key_buffer = 16M
# The MySQL database server configuration file.
!include dir /etc/mysql/conf.d/
```

MySql configuration file snippet

```
<workbenchAdvisor / >
<fastViewData fastViewLocat ion ="1024">
<orientation view="org.eclipse.ui.views.ContentOutline"
position="512"/ >
</ fastViewData >
```

Eclipse configuration file snippet

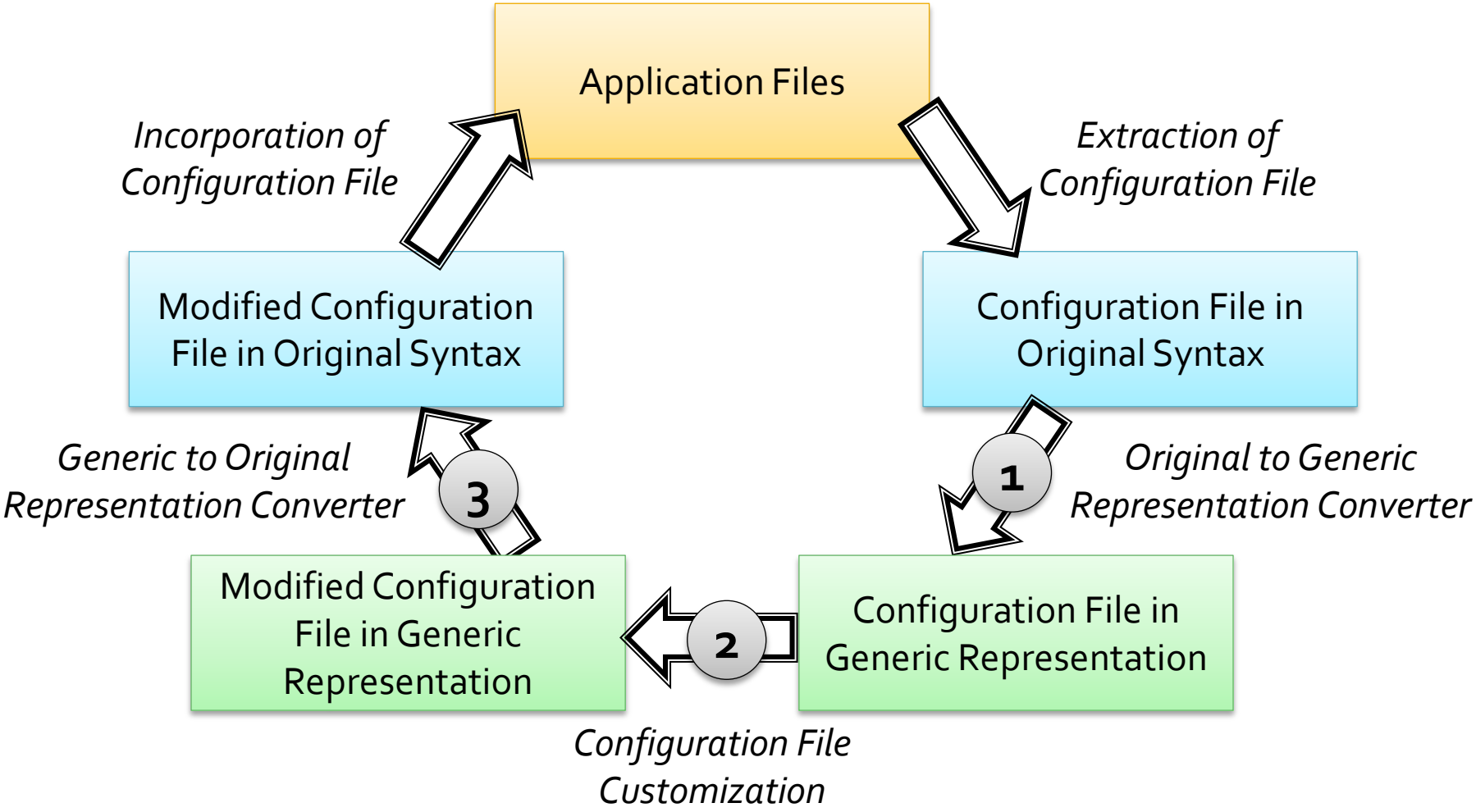
```
{
    NSGlobalDomain = { };
    sogod = {
        NGUseUTF8AsURLEncoding =YES;
        SOGoACLsSendEMailNotifications = NO;
        SOGoAppointmentSendEMailNotifications = NO;
        SOGoAuthenticationMethod = LDAP;
        SOGoDefaultLanguage = Engl ish ;
        SOGoFoldersSendEMailNotifications = NO;
    } ;
}
```

GNUstep configuration file snippet

Configuration File Analysis

- Carried on open-source applications such as *Apache*, *Eclipse*, *MySQL*, *PostgreSQL*, *GNUstep*, *Mantis*, …
- Concrete syntax differs, but resorts to the same concepts:
  - Parameter assignments
  - Block
  - Comment
  - Directive
- Applications tend to use similar formats, such as INI-based, XML-based or Block-based

An Application Reconfiguration Framework



Original to Generic Syntax Converter (O2G)

- Parses configuration files into an abstract representation and then generates them in a generic structure
- Embeds original syntax of configuration file in the generic representation
- Structured in a three-tiered schema
  - Presentation
  - Logical
  - Storage

Original to Generic syntax Converter

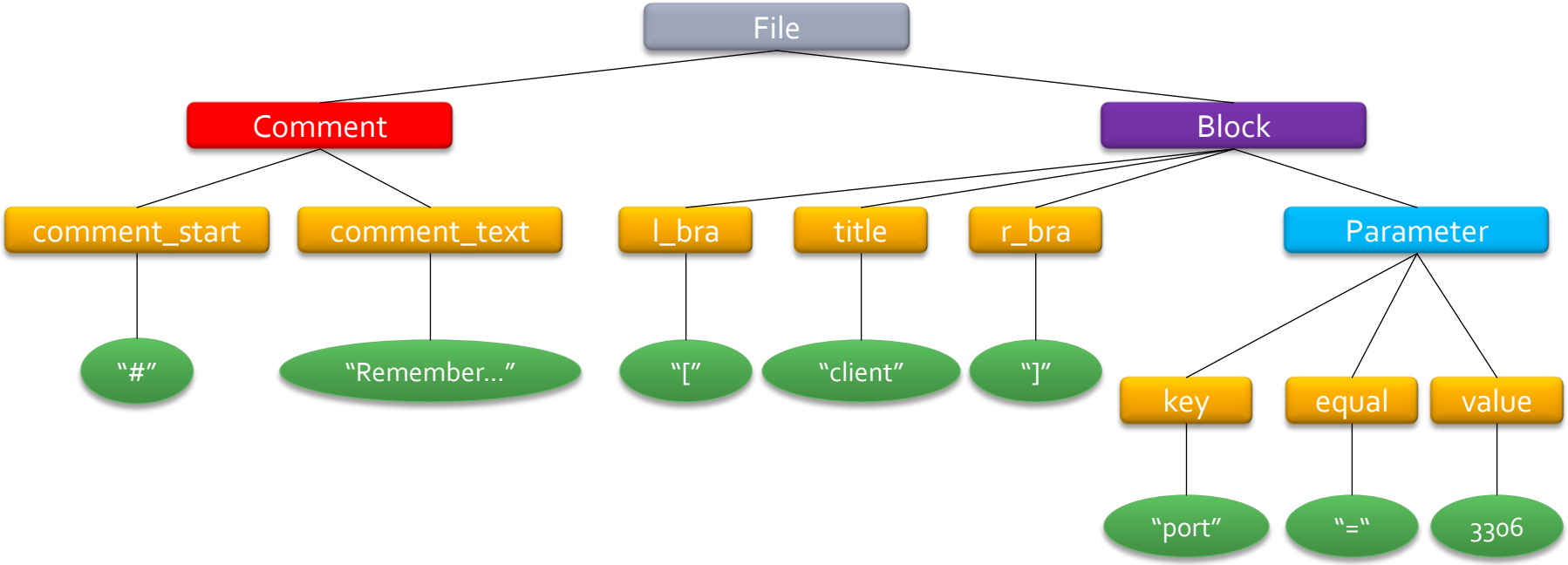
- MySQL configuration file snippet

```
# Remember to edit
  /etc/mysql/debian.cnf when
  changing the socket location.
[client]
port = 3306
```

Original to Generic syntax Converter

- File's abstract syntax tree

```
# Remember to edit
/etc/mysql/debian.cnf when
changing the socket location.
[client]
port = 3306
```

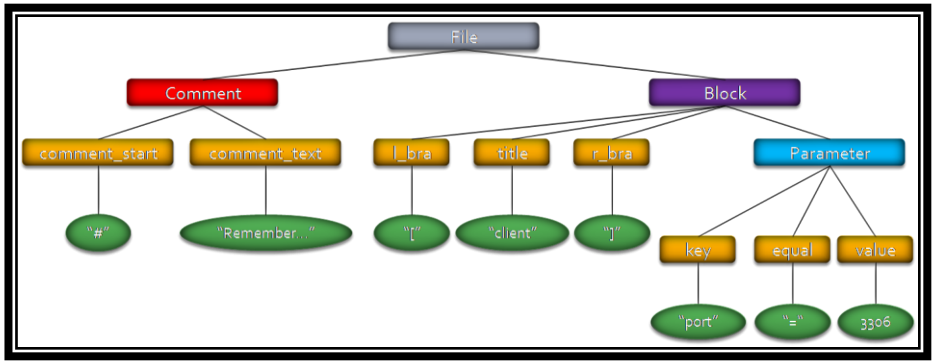


Original to Generic syntax Converter

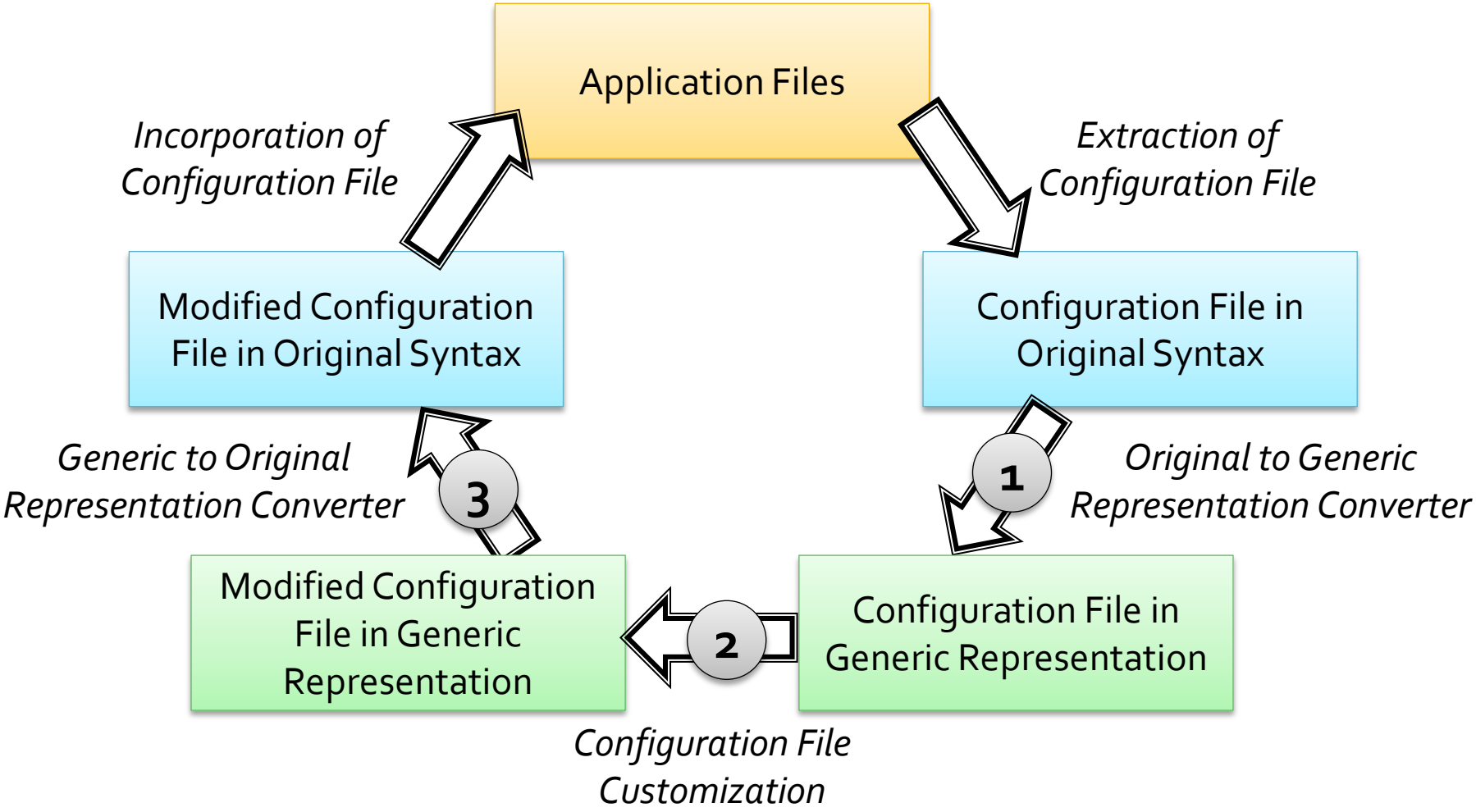
- Configuration file in XML

```
<Metadata>
  <Comment>
    <Start>#</Start>
  </Comment>
  <Block>
    <LBra>[</LBra>
    <RBra>]</RBra>
  </Block>
  <Parameter>
    <Equal>=</Equal>
  </Parameter>
</Metadata>
```

```
<File>
  <Comment>
    <FStr>%m.Start%e%n</FStr>
    <Text> Remember...</Text>
  </Comment>
  <Block name="client">
    <FStr>%m.LBra%a.name%m.RBra%n%c</FStr>
    <Parameter>
      <FStr>%e%m.Equal%e</FStr>
      <Key>port</Key>
      <Value>3306</Value>
    </Parameter>
  </Block>
</File>
```



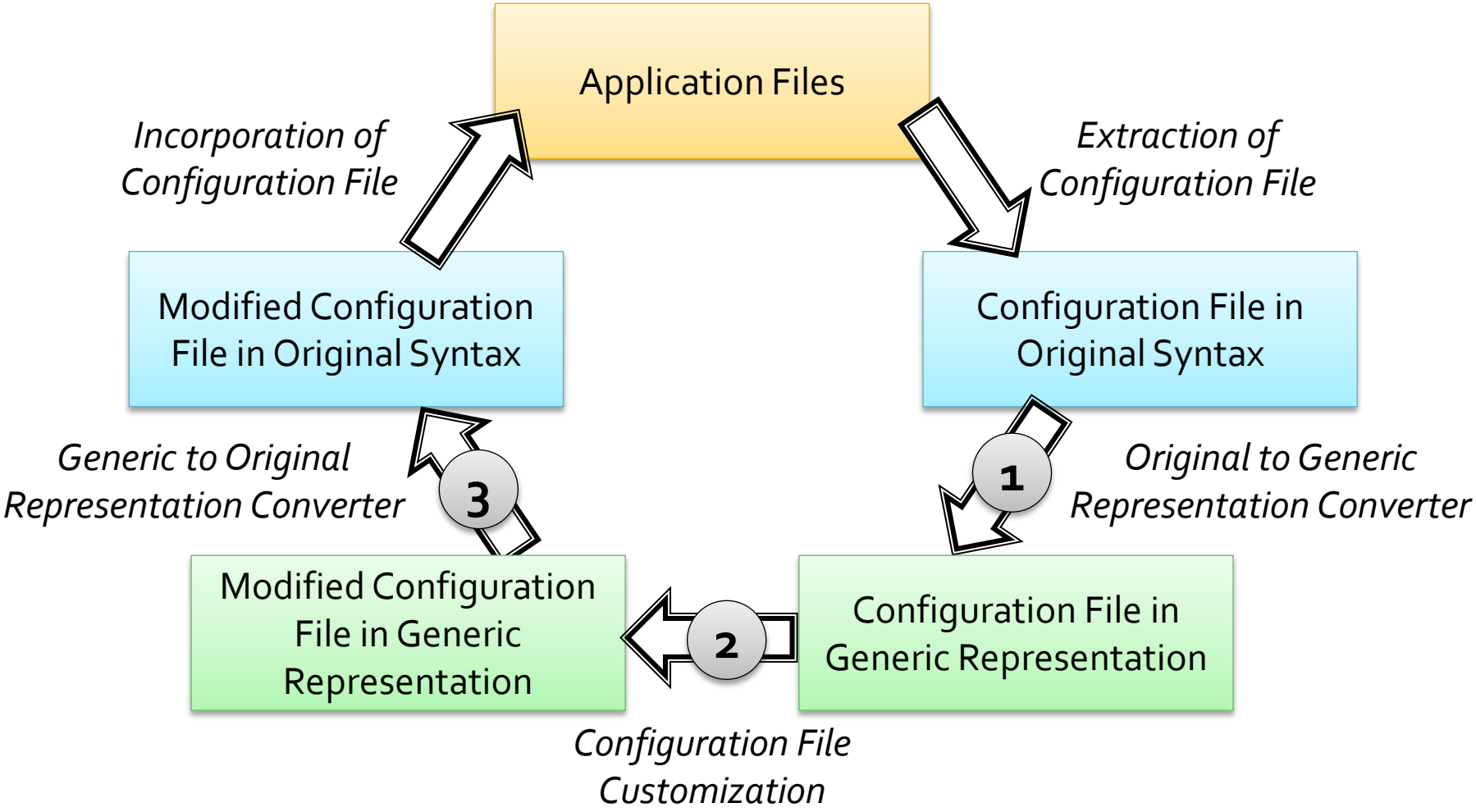
An Application Reconfiguration Framework



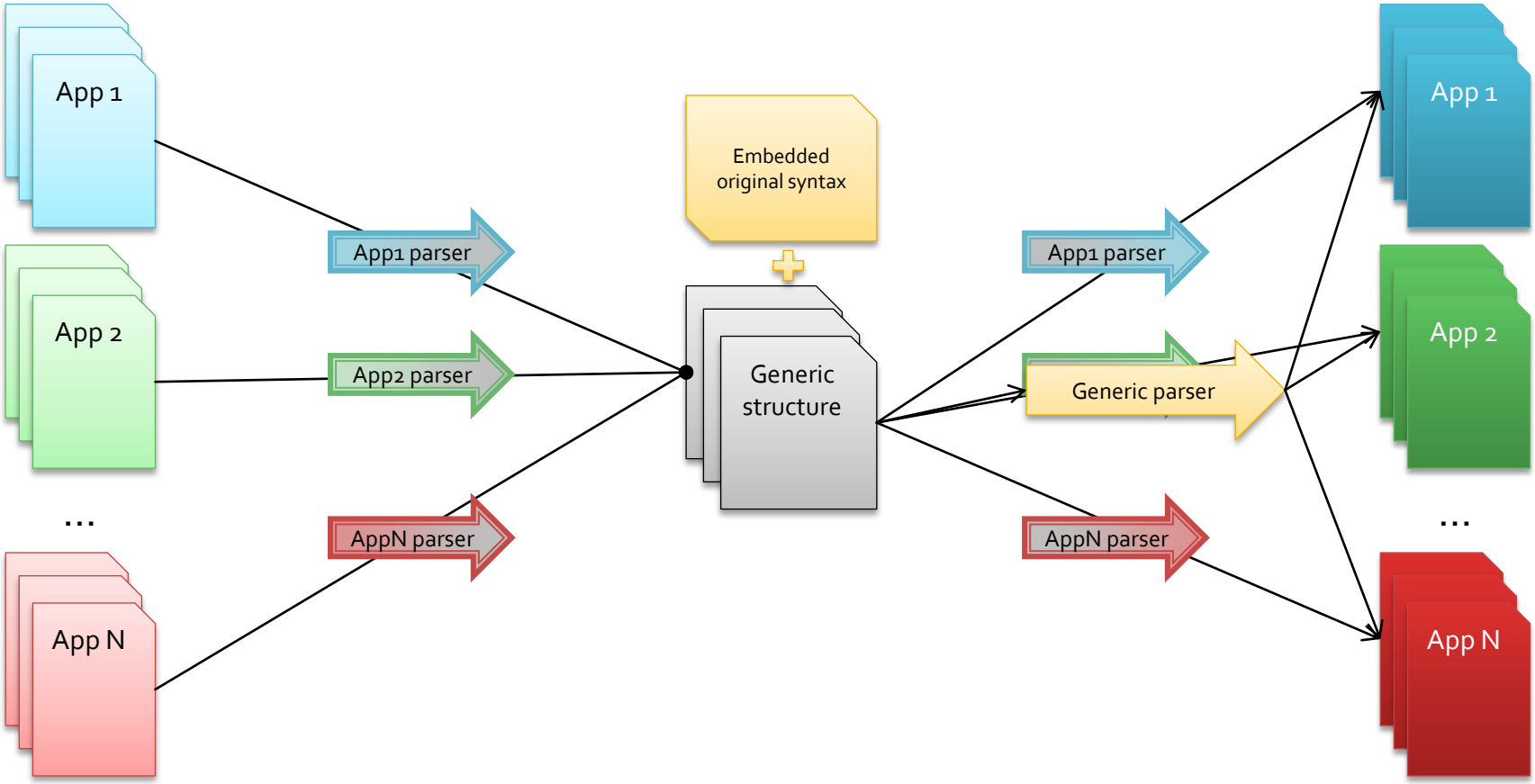
Configuration File Customization

- **Systemic configuration of applications** is made possible
- Script which operates on generic syntax is ran on the configuration file

An Application Reconfiguration Framework



Generic to Original Syntax Converter (G2O)



Generic to Original Syntax Converter

- Complements O2G by converting the intermediate representation back to its original syntax
- Operates solely on intermediate representation, completely decoupled from O2G

```
<Metadata>
  <Comment>
    <Start>#</Start>
  </Comment>
  <Block>
    <LBra>[</LBra>
    <RBra>]</RBra>
  </Block>
  <Parameter>
    <Equal>=</Equal>
  </Parameter>
</Metadata>
```

```
<FStr>%m.Start%e%n</FStr>
```

Framework Requirements

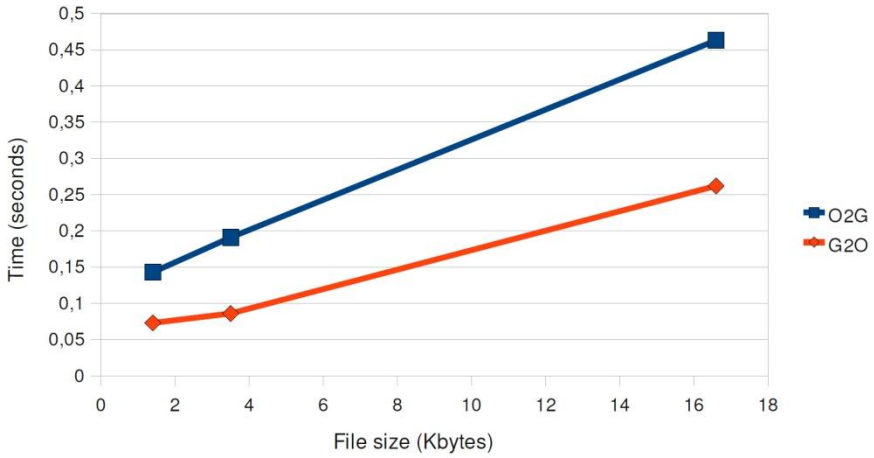
- Besides basic functionality, framework is also required to:
  - aid users writing grammars for new configuration file languages (usability, extensibility);
  - compile grammars in order to generate parsers (functionality);
  - store new parsers (extensibility);
  - import existing parsers (extensibility);
  - …

Framework Evaluation

- Based on the implemented prototype
- We evaluated the framework from three different angles:
  - Functionally: verified that all the requirements were met
  - Operationally: several tests were conducted to assure the correctness of the framework transformations

Framework Evaluation

- Performance: time required by O2G and G2O to perform their transformations



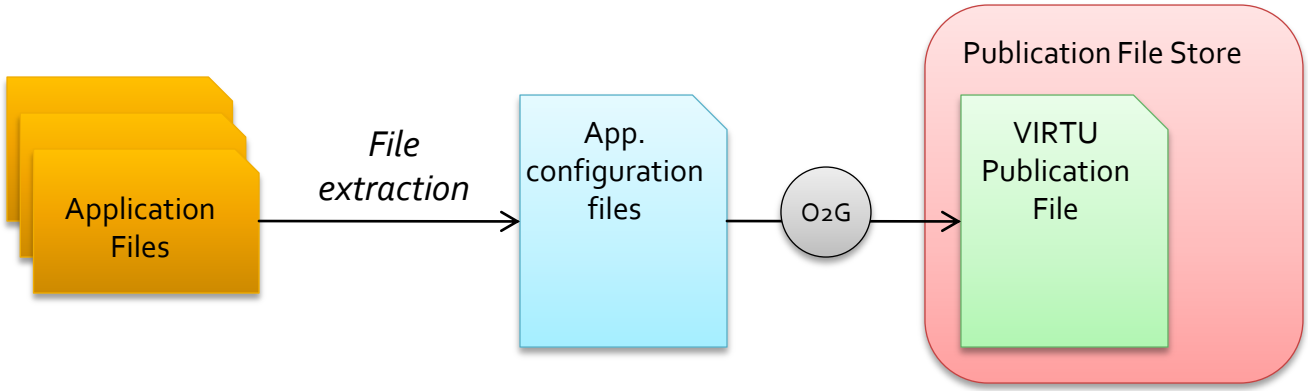
Elapsed times on O2G and G2O transformations

INI-based	XML-based	Block-based
0,27 sec.	0,28 sec.	0,30 sec.

Elapsed times on parser generation

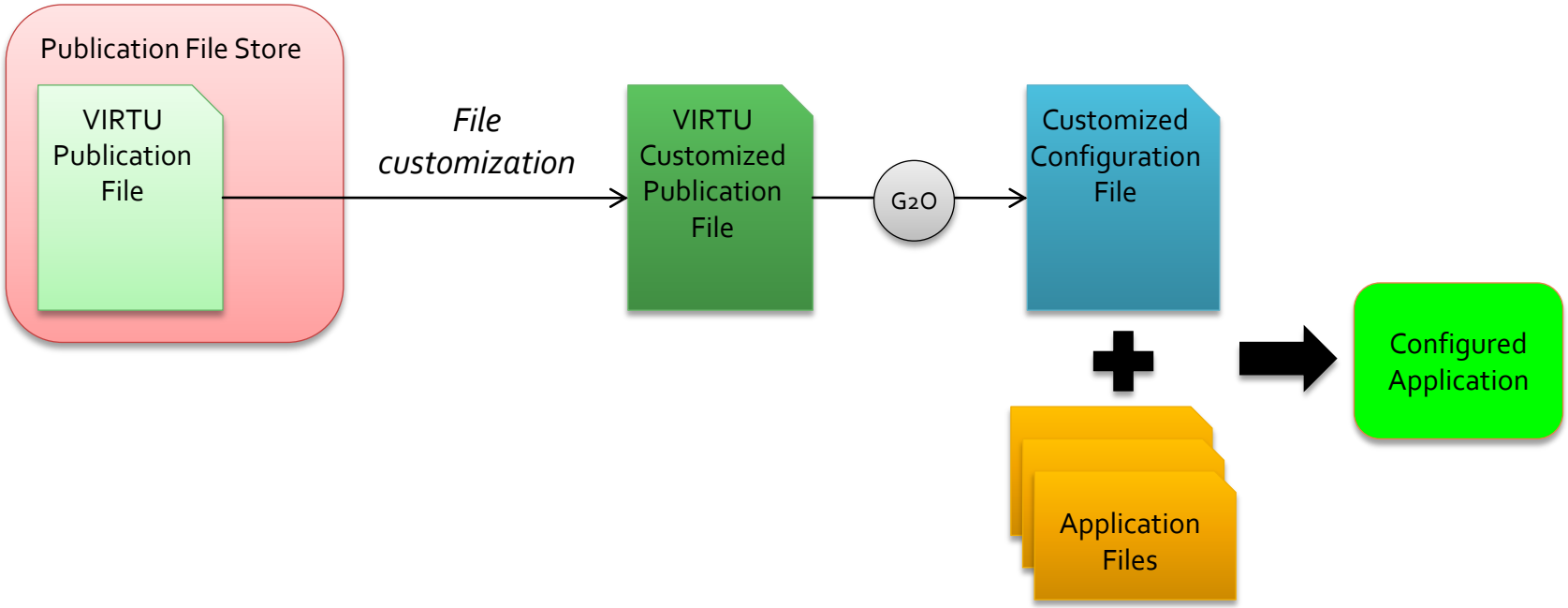
VIRTU Integration

- Template creation



VIRTU Integration

- Application deployment



Conclusion

- To the best of our knowledge, ours is the first approach to exploit similarities among configuration files
- Proof-of-concept implementation supports three format categories, but is extensible to others
- Developed prototype was integrated with VIRTU (http://virtu.evolve.pt/) solution by Evolve Space Solutions
- A SmART use case was presented: *Open virtualization framework for testing ground systems. In: PADTAD 2010: Proceedings of the 8th Workshop on Parallel and Distributed Systems: Testing, Analysis, and Debugging. Trento, Italy (2010)*

Future Work

- Broaden the scope to binary configuration files
- Improve user's grammar construction assistance
- Use of grammar inference to help **creating new parsers**

Thank you

Any questions?